SUBMISSION AGREEMENT
BETWEEN
THE NATIONAL GEOPHYSICAL DATA CENTER MARINE GEOLOGY AND GEOPHYSICS DIVISION
AND
THE NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
FOR NGDC GEOMAGNETISM DATA SOURCES AND PRODUCTS

2014-03-24

Introduction

This document represents the agreement that the National Geophysical Data Center Marine Geology and Geophysics Division (NGDC>MGG) (the "Provider") and the National Centers for Environmental Information (NCEI) (the "Archive") have reached for submitting the Provider's data, NGDC Geomagnetism Data Sources and Products, to the Archive for long-term preservation. It represents a joint effort between the Provider and the Archive to accurately document the agreement and the expectations between the two groups.

In order to ensure that the quality and integrity of the archived data is not compromised, the Provider and the Archive agree to maintain this agreement with accurate and up-to-date information through the life of the data submission.

Preserving magnetic models is necessary in order to maintain a standard for navigation throughout time, and retain the ability to recreate a journey as it was in the past. Many of the models hosted at NGDC are developed for the United States Department of Defense(DOD) and the National Geospatial-Intelligence Agency(NGA).

The World Magnetic Model (WMM) is the U.S. DoD and NATO standard model for navigation. It is a spherical harmonic model of the Earth's magnetic field to degree and order 12 for both the main field and secular variation. It is used by NOAA's Nautical Charting, the FAA for Aeronautical Charting, the DOD, NATO, the IHO, as well as civilians for navigation and heading reference systems. The Enhanced Magnetic Model (EMM) is a spherical harmonic model that includes crustal as well as main field magnetic fields. It is developed for NGA to a higher order and degree than the WMM. The increased order and degree creates a higher resolution model of the Earth's magnetic field, thus greater pointing accuracy.

The High Definition Geomagnetic Model (HDGM) is a key data product at NGDC that is widely used by directional drilling companies. Having greater pointing accuracy than even the EMM, the HDGM accounts for internal, external, and crustal magnetic fields that may affect navigational instruments. Having precise location of horizontal wells is a key safety issue for current and future resource exploration.

The International Geomagnetic Reference Field (IGRF) is an international standard research magnetic field model. The IGRF is the product of a collaborative effort between magnetic field modelers and the institutes involved in collecting and disseminating magnetic field data from satellites, observatories, and surveys around the world, organized by the International Association of Geomagnetism and Aeronomy (IAGA). NGDC is a key contributor to, and distributor of the model.

The US Historic Declination Model is the primary model for updating old property boundaries based on magnetic surveys within the conterminous U.S. The GUFM is a global model providing position and navigation information based on data points that are centuries old. It is necessary to archive these models in order to recreate the exact

working conditions as available in the past.

Contacts

Persons included in all communications regarding the data submission.

Provider Contacts

Point of Contact, Point of Contact
Brian Meyer
NGDC>MGG
Geomagnetic Data Manager
303-497-6125
brian.meyer@noaa.gov

Archive Contacts

Data Acquisition, Stewardship
Brian Meyer
NGDC>MGG
Geomagnetic Data Manager
303-497-6125
brian.meyer@noaa.gov

Management
Sue Mclean
NGDC>MGG
Division Chief
303-497-6478
susan.mclean@noaa.gov

Data Overview

NGDC ingests, describes, stewards, and develops models / products from marine, ground-based, airborne, and satellite magnetic observing platforms. The World Magnetic Model (WMM) developed by NGDC from these data is the DoD and NATO standard model for navigation and is the NOAA and FAA model used for nautical and aeronatical charting. The model is also embedded into nearly all GPS units and cell phones as well as many cameras, watches, and mapping applications that display or determine bearing or which way is "north".

The data to be archived will consist of various geophysical data, models and calculators. These products are used to represent the Earth's magnetic field over its entire surface, as well as modeling how it changes over time. The World Magnetic Model (WMM), Enhanced Magnetic Model (EMM), and High Definition Geomagnetic Model (HDGM), International Geomagnetic Reference Field (IGRF) are global geomagmetic data models that are produced once every 5 years (HDGM is annual). The United States Historical Declination Calculator (USHD) and the GUFM1 are historic geomagnetic models that are appropriate for navigational and positional corrections for data before modern magnetic observations.

The IGRF is an international research standard for magnetic field modelling. It is created by the International Association of Geomagnetism and Aeronomy (IAGA). NGDC is the host for the main IAGA webpage, and are a key distributor of the model. The current version is the 11th version of IGRF, and was produced in 2010 and has a health of 5 years.

The US Historic Declination calculator is used to settle historic boundary disputes within the conterminous U.S. and is important to maintain for consistent historic positioning. The USHD spans from 1750 to the present, and only has coverage for the conterminous US. The GUFM is a global model that models the magnetic field from 1590-1990 using historical observations.

The WMM is a spherical harmonic representation to degree and order 12, resolving the magnetic field at 3000km

resolution. The World Magnetic Model is a joint product of the United States National Geospatial-Intelligence Agency (NGA) and the United Kingdoms Defence Geographic Centre (DGC). The WMM was developed jointly by the National Geophysical Data Center (NGDC, Boulder CO, USA) and the British Geological Survey (BGS, Edinburgh, Scotland). This model is the standard model used by the U.S. Department of Defense, the U.K. Ministry of Defence, the North Atlantic Treaty Organization (NATO) and the International Hydrographic Organization (IHO), for navigation, attitude and heading referencing systems. It is also used extensively by civilian navigation and heading systems. The WMM is developed primarily from satellite magnetometer data, and represents the magnetic field produced by the Earth's core. This model is released every 5 years and NGDC is responsible for the archive of past models as well as the development of the new generation model. The WMM2015, covering 2015-2020, will be released in December 2014.

The EMM extends to degree and order 720, resolving magnetic anomalies down to 56km wavelength. The higher resolution results in significantly improved pointing accuracy. The EMM was compiled from satellite, marine, aeromagnetic, and ground magnetic surveys and observations. The EMM is applicable for a 5 year period after its production. This research model is typically released within 3 months of the WMM.

The HDGM is a model designed for use by directional drillers in order to locate and orient the drill bit and map the entire borehole location below the surface. The model includes the Main Field, Secular variation, the crustal field to degree 720, and a basic model of the external field. The HDGM is released annually for a fee with a scope of 1 year.

Applicable and Reference Documents

Documents applicable to or referenced from this agreement.

1. Maus, S., McLean, S., Pavlis, N.(2013) Memorandum of Agreement with National Geospatial-Intelligence Agency (NGA) and the National Geophysical Data Center (NGDC) During the Period Fiscal Year 2013 Through Fiscal Year 2017. National Geophysical Data Center, NOAA.

Submission Scope

Active Submission Period

2014-02-06 - 2024-12-31

Data Types

Below is a summary of the data sizing and submission schedule by data type group. Enter information on at least one data type.

Data Type Name	Data Sizing	Submission Schedule
Geomagnetic Models based on algorithms and coefficient files.	Each model contains various components that range from 100's of KB to 10's of MB	The initial archiving of the currently available models, once started, will take place over the course of two weeks. This includes the building of the folder structures, and the actual archiving process. Subsequent deliveries specified below.

Reviews and Testing

All models and calculators were developed and tested at NGDC.

Providing System

Identification of the system providing the data to NCEI.

System Name:	Brian Meyer
System Owner:	NGDC>MGG
Physical Location:	325 Broadway, DSRC, Boulder, CO 80305
Additional Information:	N/A

Transfer Interface

All data is public and made available online at either ngdc.noaa.gov/geomag or geomag.org. All models will be provided as organized zip files. All archive packages will be ingested via internal ingest/archiving systems.

Submission File Inventory

Information on each submitted file type from the Provider. Information on multiple file types can be added below.

File Type Name: World Magnetic Model 2010 (WMM)
File Name Pattern:
<Model>_<Year>.tar.<compression>
File Name Field Definitions:
Model is the specific algorithm being used.
Year is the year that the model was produced.
Example File Name:
WMM_2010.tar.gz
File Format: gzip
File Compression: gzip
File Size Average: 10MB
File Size Range: 35KB to 50KB
File Count (Rate): 1 submission package for each model (every 5 years). 1 Coefficient file, and 1-3 metadata/documentation files
Data Volume (Rate): Unknown
Submission Schedule: As produced (approx. every 5 years)
Additional Information: SIP contents in self-described ASCII format.
Descriptive Information Attributes:
None: date/time fields are usually used as descriptive attributes for this file.

File Type Name: Enhanced Magnetic Model
File Name Pattern:
<Model>_<Year>.tar.<compression>
File Name Field Definitions:
Model is the specific algorithm being used.
Year is the year that the model was produced.
Example File Name:
EMM_2010.tar.gz
File Format: gzip
File Compression: gzip
File Size Average: 200KB
File Size Range: 1KB to 719MB
File Count (Rate): 1 submission package for each model (every 5 years). 1 Coefficient file, and 1-3 metadata/documentation files
Data Volume (Rate): Total data volume and/or the data volume rate at which this file will be submitted
Submission Schedule: As produced (approx. every 5 years)
Additional Information: SIP contents in self-described ASCII format.
Descriptive Information Attributes:
None: date/time fields are usually used as descriptive attributes for this file.

File Type Name: International Geomagnetic Reference Field
File Name Pattern:
<Model>_<Year>.tar.<compression>
File Name Field Definitions:
Model is the specific algorithm being used.
Year is the year that the model was produced.
Example File Name:
IGRF_2010.tar.gz
File Format: gzip
File Compression: gzip
File Size Average: 10KB
File Count (Rate): 1 submission package for each model (approx. every 5 years). 1 Coefficient file, and 1-3 metadata/documentation files
Data Volume (Rate): Total data volume and/or the data volume rate at which this file will be submitted
Submission Schedule: As produced (approx. every 5 years)
Additional Information: SIP contents in self-described ASCII format.
Descriptive Information Attributes:
None: date/time fields are usually used as descriptive attributes for this file.

File Type Name: High Definition Geomagnetic Model
File Name Pattern:
<Model>_<Year>.tar.<compression>
File Name Field Definitions:
Model is the specific algorithm being used.
Year is the year that the model was produced.
Example File Name:
HDGM_2014.tar.gz
File Format: gzip
File Compression: gzip
File Size Average: 25KB
File Count (Rate): 1 submission package for each model (every year). 1 Coefficient file, and 1-3 metadata/documentation files
Data Volume (Rate): Total data volume and/or the data volume rate at which this file will be submitted
Submission Schedule: As produced (annual)
Additional Information: SIP contents in self-described ASCII format.
Descriptive Information Attributes:
None: date/time fields are usually used as descriptive attributes for this file.

File Type Name: United States Historic Declination Calculator (USHD) and GUFM
File Name Pattern:
<Model>_<Year>.tar.<compression>
File Name Field Definitions:
Model is the specific algorithm being used.
Year is the year that the model was produced.
Example File Name:
gufm1_2000.tar.gz
File Format: gzip
File Compression: gzip
File Size Average: 10KB
File Count (Rate): 1 submission package for each model. 1 Coefficient file, and 1-3 metadata/documentation files
Data Volume (Rate): Total data volume and/or the data volume rate at which this file will be submitted
Submission Schedule: One time submission to archive
Additional Information: SIP contents in self-described ASCII format.
Descriptive Information Attributes:
None: date/time fields are usually used as descriptive attributes for this file.

Submission Manifest

A submission manifest file with a 32-character MD5 checksum value is required for each submitted file in order to ensure the integrity of the submitted data.

File Content Specification:

In the current scheme, given the internal packaging and ingest arrangement for this data set, no submission manifest will be supplied. Instead, prior to archival of each data package, a test will be run to check the compressed file integrity. If file is ingested via the Enterprise Ingest System (EIS), an md5 checksum file will accompany the SIP to initiate ingest as well as used to validate the SIP. This ASCII file will contain checksum information of the SIP.

File Transmission:

N/A in current scheme, but if EIS is used, an md5 file will accompany the SIP and deposited to a specified staging area for ingest and validation.

File Name Pattern:

N/A in current scheme, but if EIS is used, the accompanying md5 file will have the same file name of the SIP but with an .md5 extension.

File Name Definitions:

N/A in current scheme. See descriptions above if EIS is utilized.

Example File Name:

N/A in current scheme. If the EIS is used, the example would be: <Model>_<Year>.md5

Archive Ingest

Ingest processing steps at the Archive and communication with the Provider.

Receipt Verification:

Internal NGDC ingest logging and cataloging systems will supply information as to the assimilation of data in archive system.

Error Reconciliation:

The Archive will report any problems or errors with file integrity, file name, checksum validation, or other errors that inhibit the data ingest and archive. NGDC supplies data managers with an Errors Tracking database that flags any errors with the data submissions.

Receipt Confirmation:

Successful data submission to the Archive will be reflected in catalogue entries to the Archive Catalog.

Quality Assurance:

No quality checks on the submitted data are planned.

Archive File Packaging:

Same as SIP.

Archive Storage

Archive attributes of each archived file type.

Archive File Type Name: Archive filename/type will be same as the original submission package.

Archive File Attributes/IDs:

Attribute/ID Type	Value
Storage System	archive/models/geomagnetism/<model>/data/<model>_yyyy.tgz

Archive Updates

Newer data sets will be archived as they are completed on regular schedules, as noted above. If errors are identified with existing AIPs, the updated copy will be archived along side the existing copies if the error laden copy has been disseminated. Updates are expected to be infrequent: 1 per model produced every five years (WMM,EMM,IGRF); Likely not to happen for HDGM; Probably none for the GUFM and USHD. Updated files will add a version ID to the existing file name. Any updates to error laden models will be appropriately documented and redistributed. It is important to maintain copies of all disseminated magnetic models, even models containing errors, in order to recreate working conditions.

Retention Schedule

The data will be retained in the Archive for long-term preservation in accordance with NOAA data management standards. Information on data usage and archive value may be used for making decisions on continuing the duration of the archive.

(Notional) Disposition: Unknown/TBD

Constraints

No constraints apply or will apply to the archived data.

User Community

The global magnetic map is useful in science education to illustrate various aspects of Earth evolution such as plate tectonics and crustal interaction with the deep mantle. Geophysical magnetic models and calculators are also used for accurate navigation and positioning on or near the Earth's surface, past, present, and future by scientists, military, and citizens alike.

User Documentation and Metadata

The Provider will supply information to the Archive for writing and maintaining standard archive metadata, which includes data discovery information, references and data archive access links for users. The following published documents and archived items will be referenced from the metadata and made available to users.

Representation Information Items

For data to be useful to users, present and future, its format specification and characteristics must be documented and preserved with the data. Representation Information provides users with syntax (structure) and/or semantics (meaning) to decode the encoded data.

Item	Description
http://www.epm.geophys.ethz.ch/~cfinlay/gufm1/Jacksonetal2000.pdf	Research paper describing the development of GUFM1

http://www.ngdc.noaa.gov/geomag/WMM/data/WMM2010/WMM2010_Report.pdf	World Magnetic Model 2010 published research paper
http://onlinelibrary.wiley.com/doi/10.1111/j.1365-246X.2010.04804.x/full	Research paper describing the development of the IGRF

Preservation Descriptive Information Items

Preservation Descriptive Information items contain context, provenance, and/or quality information for the data.

Item	Description
Geophysical Models Metadata WAF	http://www.ngdc.noaa.gov/metadata/published/NOAA/NESDIS/NGDC/MGG/Geophysical_Models/iso/
Geomagnetic Reference Models, ISO TC 20/SC 14 N, 2013-04-22.	This International Standard defines reference models representing the geomagnetic field: http://www.iso.org/iso/catalogue_detail.htm?csnumber=57448

Access and Dissemination

Most access will be handled via the NGDC Geomagnetic Team webpages: http://www.ngdc.noaa.gov/geomag/. The Archive will provide access services for the data and supporting information to the designated user community upon request.

Additional Terms

None.